

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)	
)	
Inquiry Regarding Carrier Current Systems)	ET Docket No. 03-104
Including Broadband over Power Line)	
Systems)	

COMMENTS OF AMPERION, INC.

Pursuant to Section 1.415 of the Federal Communications Commission (“FCC”) Rules, Amperion, Inc. hereby submits comments in response to the *Notice of Inquiry* (NOI) in the above referenced proceeding. Amperion applauds the FCC for initiating this NOI and provides the following information in support of the Broadband over Power Lines (BPL) industry and suggestions for further encouraging its development. This development is necessary in order to promote consistency and clarity in the rules, which will help make the wide array of benefits of BPL technology available to a broader customer base throughout the United States.

1. Summary

Amperion, Inc. is a pioneering medium-voltage (MV) BPL company that develops networking hardware and software to enable the delivery of high-speed broadband data over the medium-voltage utility lines. Amperion's products allow service providers and utilities to use existing powerline infrastructures to provide high-speed data transport and enhanced utility services economically and with minimal capital investment.

Established in June 2001, investors include American Electric Power, a leading wholesale energy provider and one of the largest electric utilities in the US; Cisco Systems, Inc., the worldwide leader in networking; and Redleaf Group, Inc, a venture operating company.

Amperion's technology is unique in the Access BPL industry in that it uses only the MV electric infrastructure to transmit broadband signals. Amperion's preferred solution for delivering bandwidth to the end user is via PowerWiFi™, which is a standards-based Amperion technology that links the power line network to customers via an 802.11b connection. PowerWiFi™ uses only FCC-approved equipment that complies with industry standards and provides the best solution in safety, scalability, economics and is globally accepted. This approach means that Amperion's equipment does not involve putting a signal on the low-voltage (LV) lines and therefore, there is no conducted path into a customer premises.

Amperion has several major deployments of its equipment operating in the field with its utility partners. We have performed extensive emissions testing for all of our underground and overhead equipment at each field deployment site. The comprehensive test data that has been collected confirms that Amperion equipment is compliant with Part 15 emission limits. We have provided this data directly to the OET and will continue to proactively work with the Commission in this area. We have also had no complaints or instances of interference at any of these deployment sites. As a result of this compliance, Amperion is presently selling commercially available equipment for market deployments in the US.

2. Amperion Technology

Amperion has three main products, each of which is included in our underground and overhead product lines:

- The **Injector** is the interface between the network access connection (e.g. fiber ring, DS3, DS1) and an MV feeder. Typically, one injector is installed per MV feeder. Once on the wire, the signal is either repeated to extend its reach or extracted to deliver bandwidth to the customer.
- The **Extractor** is the device that connects the PLC network to the bandwidth destination. Bandwidth can be delivered to a business, residence, MTU/MDU, utility device, wireless tower, or remote DSLAM.
- The **Repeater/Extractor** provides both extractor and repeater functionality. The **repeater** is quite sophisticated and does not simply amplify the signal (and consequently

the noise as well). Instead, it fully receives a signal sent from an injector (or another repeater), error corrects for the noise, decodes the IP datagram, routes the packet, and retransmits the packet down the MV feeder. Spacing is dependent upon the desired bandwidth, application, noise on the line, and whether latency is within voice-fidelity limits.

Connecting to Customers

As mentioned in the summary, PowerWiFi™ access is Amperion's preferred solution to deliver bandwidth to the end user. This standards-based Amperion technology links the power line network to customers via an 802.11b connection. The 802.11 device located at the premise can link: directly to a computer/computers; to an Ethernet LAN; to premise-based wireless networks; or to in-home PLC. Amperion products easily integrate with other premise access technologies to provide additional bandwidth delivery and backhaul alternatives.

Amperion Connect products use standards-based components and are designed to seamlessly fit into utility and service provider networks. Key equipment features include:

- **Grid Independence** - Amperion equipment is designed to be seamlessly deployed into medium voltage power networks and is installed using existing tools, techniques and work crews.
- **Secure Access** - Amperion supports a variety of layer 2 and layer 3 security standards along with user access, authentication and anti-denial of service measures enabling carriers to offer the highest level of secure services to their end users.
- **Power and Reliability** - Amperion units are designed to meet stringent carrier availability requirements. The units feature an integral reclosure event battery that enables the units to remain active during short-term power disruptions. Longer term batteries for outage coverage are also available.
- **Simple to Install and Easy to Use** - Amperion equipment is installed using industry standard tools and techniques, minimizing the installation and training time of line crews. Overhead units are inductively coupled, fastening to the line like a "bird on a wire." The underground units inductively connect around the insulation. Both products can be safely

deployed on energized circuits. All Amperion products contain an auto discovery feature that enables newly installed equipment to be automatically discovered and configured by the network.

- **Flexible Bandwidth Provisioning** - The Amperion architecture allows carriers to assign a specific upstream and downstream data rate to each customer. Upgrades to customer bandwidth can be performed in minutes through standards-based Simple Network Management Protocol (SNMP) and Command Line Interface (CLI).

Amperion is pleased to present information in this document that addresses specific questions that the FCC has included in this NOI in order to further the education of the Commission and other parties that are interested in Amperion and the Access BPL industry. We look forward to continuing this sharing of information throughout as the industry continues to move forward.

3. General BPL Information

Responses to NOI Questions:

- **3.1 Frequency band:** Amperion has used the 1.7 - 30 MHz frequency band in its trial deployments using experimental licenses under 47 C.F.R. § 5 granted by the Commission. These same trials were tested and validated to Part 15 emission limitations. Amperion suggests that the possibility of using frequencies up to 50 MHz, and the associated rules, should be explored during this proceeding.
- **3.2 Data transmission speeds:** Deployments of Amperion equipment have achieved data transmission speeds of 18-24 Mbps on the MV networks of all of our utility partners. This performance has been consistently demonstrated under normal user environment conditions. Using Amperion's PowerWiFi technology, bandwidth is able to be delivered to end user customers at up to 4-5 Mbps, with asymmetric delivery of the data of approximately 2/3 downstream and 1/3 upstream.
- **3.3 Modulation technique:** Amperion uses Orthogonal Frequency Division Multiplexing as its modulation technique.
- **3.4 Access/In-House Integration:** Additional equipment would be needed for Access

products to work with In-House BPL products and services.

- **3.5 Commercial availability:** Amperion is presently selling commercially available equipment for market deployments in the US.

4. Interference-Related Issues

Amperion has conducted extensive emissions testing for all of its underground and overhead equipment at each field deployment site. The detailed data collected confirms that Amperion's equipment is compliant with existing Part 15 emission rules. This data was submitted to the FCC earlier this year for analysis and confirmation of this compliance. Further, there have been no complaints at any of our trial deployments.

Other Access BPL companies have also performed similar testing and are claiming to be compliant with the present rules, so the industry has made tremendous progress towards collecting relevant data in this very important area.

Responses to NOI questions:

- **4.1 Filters:** High-pass filters are not required to transfer high frequency signals beyond the low-voltage distribution transformer due to Amperion's PowerWiFi™ technology and implementation. As stated earlier, this PowerWiFi™ approach uses FCC-approved equipment that complies with industry standards. In effect, Amperion uses the distribution transformer to block signal coupling to the low voltage distribution. This eliminates the issue of interference with high-frequency signals inside the premises and thus allows frequency re-use.
- **4.2 Signal injection:** Amperion inductively couples its signal on the MV phase and return through the ground wires. The level of unintentional radiation experienced is within present Class B limits.
- **4.3 Interference mitigation:** Due to the fact that Amperion's signals do not pass through the distribution transformer at any significant SNR, we do not believe that there is a need to define frequency bands that must be avoided in order to protect the licensed users on the same frequencies.

- **4.4 Definition of Class A/B for BPL:** With respect to whether Access BPL equipment, or any form of unintentional radiator, should be treated as operating in a residential (Class B) or commercial (Class A) environment, Amperion believes that this should be treated based on relative distance from a residence (i.e. within 10 meters of a residence, Class B; beyond 30 meters from a residence, Class A). This would adequately limit the exposure of equipment within a residence to unintentional interference. Amperion also believes that in instances where Access BPL technology is limited to deployment on MV wires with no LV conducted path into the home, this equipment should clearly be considered Class A products.
- **4.5 Proximity to other equipment:** We are not aware of any effects that the proximity of Access BPL equipment to cable and telecom equipment from third party service providers co-located on the same utility pole has on the operation of these services.
- **4.6 Predictive models:** Amperion continues to work on developing models that would help predict radiated emissions from our systems. We are still investigating the patterns and distances of radiation from our MV products but a completed product is not yet available; we have had meaningful discussions with the OET on this subject.
- **4.7 Field trial test results:** Amperion has performed extensive field testing at all of our present deployment sites. We have provided this data directly to the OET for its analysis and look forward to continuing to proactively supply the OET with further test results as they become available.
- **4.8 Adequacy of Part 15 rules:** We believe that the existing Part 15 rules are adequate at this time to ensure protection against harmful interference to radio services and to avoid adversely impacting the developing and deployment of this nascent technology.
- **4.9 Equipment differentiation:** The rules need to be tailored to differentiate equipment used specifically in Access BPL and In-House BPL applications. In-House BPL equipment obviously functions in a residential environment where Access BPL equipment such as Amperion's can also be deployed in purely commercial or industrial applications. Any potential interference would be easy to mitigate due to the technology and architecture mentioned earlier.

- **4.10 Radiated/conducted emission limits:** We recommend that the Part 15 rules continue to use radiated emission limits for BPL systems because this is sufficient to control interference from both low speed and high speed BPL. Since all carrier current systems inject RF signals into the power line for communication purposes, conducted emission limits will be more appropriate at some point in the future. If a typical power distribution impedance (or impedances) were to be defined, it would seem reasonable to test conducted emissions only as we could predict the effective radiated power. At present, a lack of empirical evidence exists to substantiate such test methodologies. However, we believe the sufficient amount of data should be available within the next twelve months. This would also enable testing to be performed in a controlled laboratory environment in order to increase efficiencies. Amperion looks forward to working with the OET if it decides to pursue this possible avenue in the future.

5. Measurement Methods

Amperion offers information and opinions in the important area of measurement methods and procedures. We offer our continuing support to bring additional clarity to these issues in the near future. Amperion will work together with the FCC and the rest of the Access BPL industry in order to accomplish this goal.

Responses to NOI questions:

- **5.1 Development of measurement procedures:** Development of a "typical" network impedance model would allow testing of conducted emissions that could be correlated to unintentional radiated emissions. Models of both overhead and underground distribution systems would be required. In addition, since these systems vary greatly in their performance, multiple models of each type may be required. As mentioned in 4.10, Amperion would gladly participate in the development of such a system model.
- **5.2 Collaborative approach:** In order to develop measurement procedures for testing new BPL systems, both Access and In-House, we recommend considering a collaborative effort between the BPL industry and the OET test organization. Such a working group could be formed to leverage the combined experience and talent of both parties to

develop this "standard test". These efforts will help to promote consistency with measurements of existing carrier current systems and repeatability of test results.

- **5.3 Standardized testing:** Amperion believes that a standardized test can and should be developed to test Access BPL systems for compliance. However, the characteristics of using a specialized LISN or some characterized pole and wiring assembly as the Commission suggests as possibilities are not yet clearly understood by Amperion. In addition, conventional OATS testing for unintentional radiation should also be considered. We took this approach prior to testing at our field trials.
- **5.4 Mitigation of potential interference:** Since the technology presently being employed operates at higher frequencies, there is the potential for interference with a larger number of licensed radio services. However, due to the low levels of unintentional RF radiation we have noted and the fact that the energy levels roll off quickly as you get farther from the MV wire, we do not believe our technology poses a particular risk. In addition, should a complaint manifest itself, Amperion technology can shift away from the offending frequency.
- **5.5 System verification:** We believe the entire Access BPL system should be tested and subject to equipment verification. Due to the diversity of systems, any attempt to break things down into sub-assemblies or components would likely lead only to further confusion.
- **5.6 Equipment compliance:** Amperion believes that the Verification procedure is more appropriate than Declaration of Conformity (DOC) for Access BPL equipment, as it is for traditional carrier current systems. The equipment will be sold only to utilities and service providers rather than directly to end-user customers. More importantly, only qualified utility line personnel will install the units on the power lines. This reduces the need for more stringent forms of equipment authorization, which would only impede innovation. Though we could work with Certification or DOC procedures, Amperion believes that the Verification process is more applicable.

6. Utility Applications

Amperion equipment enables a number of enhanced utility applications, which could have the ability to add tremendous value to a utility by making its internal operations much more efficient. For example, Amperion devices have the capability of detecting signal patterns that occur prior to breakdown of electrical network elements, such as faulty conductors, transformers and capacitors. This information will allow line crews to be dispatched to proactively replace these elements before they fail and cause customer outages, thus improving network reliability and performance.

Access BPL could also be used to extend traditional utility SCADA throughout the utility power grid. Such a deployment would improve customer service and system reliability and minimize utilities' reliance on customers for outage notification. These capabilities are not available with existing low-speed power line carrier technologies. Thus, predictive failure analysis and the potential physical "reach" of BPL are side benefits of BPL deployment that could lead to reliability and service improvements to utility customers.

Despite the tremendous value that these utility applications provide, they require only a small percentage of the overall available bandwidth. This allows a utility or service provider to use a large segment of the bandwidth for consumer broadband services in order to achieve a successful balanced business case. This integrated approach represents the best interests of both the utilities' ratepayers and corporate shareholders. BPL is the only technology that is available which enhances existing utility distribution facilities and provides enormous potential for economical customer connectivity.

There are dozens of other potential utility applications that could be enabled by Amperion deployments. From an operations perspective, BPL's high speed capacities will allow utilities to improve their infrastructure security and better ensure public safety. This is increasingly important due to classification by the government of specific public and private infrastructure assets, such as electric utility assets, under MEVA (Mission Essential Voluntary Assets) established by Presidential order as part of the Homeland Security policies framework guidelines. MEVA assigns additional responsibilities to utilities in order to ensure secure

infrastructure power for federal facilities, including state, city, and local government. BPL could expand the utility communications infrastructure, enabling applications such as electric facilities' video surveillance to ensure security and public safety.

Responses to NOI questions:

- **6.1 Other utility control systems:** Some of Amperion's utility partners have tested older carrier current control systems such as TWACS alongside a deployment of Amperion equipment in a residential neighborhood. The results were that absolutely no interference was detected by either system. Since the frequencies of most older systems are in the Hz or KHz range, we would not expect BPL systems in the MHz range to negatively affect them, or vice versa.
- **6.2 Monitoring and control functions:** It is important that the monitoring and control functions are protected as much as possible from the general users of Access BPL. This could be accomplished by using static addresses, Media Access Control ("MAC") layer filtering, or a Virtual Private Network ("VPN"). Each LAN connected device has a unique MAC address that can be used to filter data from/to specific devices/users to provide separation and isolation. VPN provides a secure isolated data "tunnel" which could be used to separate and protect monitoring and control data from Access BPL data.

7. Other Benefits of Access BPL Technology

BPL Provides Broadband Access to Underserved Areas

The ubiquity of the electric utility infrastructure allows BPL to provide broadband to areas in the US that do not presently have it. A large percentage of the United States still does not have access to high-speed broadband and the services that it enables. The interest from these areas has been tremendous because they recognize the potential value that BPL technology could add to their communities from economic development to quality of life. Municipally owned utilities, rural electric cooperative utilities and local governments have been especially interested in deploying this technology.

BPL Promotes Facilities-based Competition

Amperion believes that BPL will benefit the areas that its utility and service provider customers serve by providing another facilities-based medium for last-mile customer connectivity for a variety of high-speed communications services. BPL is an access medium that will likely be attractive enough to diverse broadband competitors to expand competitive breadth. Amperion supports an open access model, which would allow services providers to compete against each other to lease the BPL infrastructure to provision broadband services. This model provides a number of different parties the ability to provide broadband, including: Internet Service Providers (ISPs), Competitive Local Exchange Carriers (CLECs), Local Exchange Carriers (LEC) and cable companies. The utility that hosts the BPL equipment could still use a portion of the available bandwidth for internal utility applications.

8. Conclusion

Amperion commends the FCC for its efforts in issuing this NOI. The information provided in this document indicates that for the most part, the existing Part 15 rules are adequate to govern the BPL industry so no major revisions to the rules are being requested. Amperion and the Access BPL industry will continue to work with the FCC to try to establish further clarity in these areas to assist all parties as commercial deployments of BPL technology continue to grow. We will also continue to diligently ensure that equipment continues to comply with these existing Part 15 emission requirements.

We would also like to recognize the fact that FCC Order 97, Section 157 essentially places the burden on BPL opponents to justify why a new entrant or technology that may provide more affordable telecommunications to a broader base of customers, should not be approved. Comments filed thus far have not come close to meeting this burden, and remain unsubstantiated and speculative without direct evidence that BPL equipment causes interference in excess of approved limitations established by FCC guidelines.

Chairman Powell recently underscored the importance of having a third wire broadband medium available to provide to customers. We realize that this is one of the FCC highest priorities because it is in the best interest of American citizens and has the potential for making such a profound impact on our society. This is exactly what BPL technology can provide.

Amperion very much appreciates the opportunity to provide relevant comments and information in response to this critically important Notice of Inquiry and looks forward to continuing its active participation in the process.

Respectfully submitted,

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